

**What is claimed is:**

1. A remote maintenance system comprising:

a center server that is located in a service center for performing maintenance of an electrical appliance; and

5 a home server that is located in each house and monitors a status of an electrical appliance in a house,

wherein the center server and the home server are connected via a communication line,

the home server includes:

10 a status value acquiring unit operable to acquire a status value of each electrical appliance;

a failure model receiving unit operable to receive from the center server a failure model which is information defining a method for deriving a decision whether the electrical appliance is failed or not from the status value; and

15 a failure deciding unit operable to decide whether the electrical appliance is failed or not based on the acquired status value and the received failure model using qualitative reasoning, and

20 the center server includes a failure model updating unit operable to update the failure model and send the updated failure model to the home server.

2. The remote maintenance system according to Claim 1,

25 wherein the home server further includes:

a status value storing unit operable to store a status value at the time when the failure deciding unit decides that the electrical appliance is failed or not failed; and

30 a status value sending unit operable to send the stored status value to the center server,

the center server further includes a status value receiving unit operable to receive the status value from the home server, and

the failure model updating unit updates the failure model based on the received status value of the electrical appliance.

3. The remote maintenance system according to Claim 2,  
5 wherein the failure model includes a standard value indicating a decision basis for the failure deciding unit to make the decision.

4. The remote maintenance system according to Claim 3,  
10 wherein the failure model includes a program for having the failure deciding unit decide whether the electrical appliance is failed or not using the standard value and the status value.

5. The remote maintenance system according to Claim 4,  
15 wherein the failure model updating unit updates the standard value using a vector quantization method based on the status value.

6. The remote maintenance system according to Claim 5,  
20 wherein the standard value indicates a normal range of a relationship between the status value stored in the status value storing unit and a preset condition of the electrical appliance at the time when the status value is acquired.

7. The remote maintenance system according to Claim 6,  
25 wherein the standard value of the failure model for an air conditioner includes an upper limit value of a compressor rotational frequency during cooling operation and heating operation of an air conditioner, and

the failure deciding unit decides that an air conditioner is failed when a compressor rotational frequency during cooling  
30 operation or heating operation of the air conditioner exceeds the upper limit value.

8. The remote maintenance system according to Claim 6,  
wherein the standard value includes a coefficient of a curve  
indicating a boundary between a normal range and an abnormal  
range when a pair of the status value and the preset condition is  
5 plotted on a multi-dimensional coordinate.

9. The remote maintenance system according to Claim 8,  
wherein the failure model updating unit updates the  
coefficient of a curve by a least squares method based on a plurality  
of points indicating pairs of the status values and the preset  
10 conditions on the coordinate.

10. The remote maintenance system according to Claim 8,  
wherein the standard value includes a coefficient of a curve  
15 indicating a boundary between a normal range and an abnormal  
range on the coordinate, when an applicable electrical appliance is  
an air conditioner, the preset condition is a temperature difference  
between a preset temperature and a room temperature during  
cooling operation or heating operation of the air conditioner, and the  
20 status value is a lapsed time until the room temperature reaches the  
preset temperature.

11. The remote maintenance system according to Claim 8,  
wherein the program is a program for having the failure  
25 deciding unit decide whether the point indicating the pair of the  
preset condition and the status value on the coordinate is located  
within the normal range of the curve.

12. The remote maintenance system according to Claim 11,  
30 wherein the failure model includes a program for having the  
status value acquiring unit acquire a predetermined status value at  
a predetermined timing.

13. The remote maintenance system according to Claim 12,  
wherein the home server further includes a customer display  
unit operable to display failure information of the electrical  
appliance,

the failure deciding unit sends information specifying  
contents of a failure of the electrical appliance to the center server  
when the failure deciding unit decides that the electrical appliance is  
failed, and

the center server further includes:

a holding unit operable to hold different contents of failure  
information which are prepared beforehand for a customer and a  
serviceman separately corresponding to a failure which can occur  
per model of the electrical appliance;

a failure information sending unit operable to receive  
information specifying contents of a failure of the electrical  
appliance, specify failure information for a customer among the  
information held in the holding unit, and send the specified failure  
information to the home server; and

a serviceman display unit operable to receive information  
specifying contents of a failure of the electrical appliance, specify  
failure information for a serviceman among the information held in  
the holding unit, and display the specified failure information for a  
serviceman.

14. The remote maintenance system according to Claim 13,  
wherein the failure model receiving unit receives the failure  
model corresponding to each of the electrical appliance from the  
center server,

the failure deciding unit decides a failure of the electrical  
appliance according to the failure model corresponding to each of  
the electrical appliance, and

the failure model updating unit sends to the home server the updated failure model with indication of the corresponding electrical appliance which is decided to be failed.

5 15. The remote maintenance system according to Claim 14,  
wherein the home server further includes:  
a new electrical appliance detecting unit operable to detect an electrical appliance which is newly connected to the home server;  
and

10 a failure model requesting unit operable to request the center server to send the failure model corresponding to the electrical appliance when the new electrical appliance is detected,

the failure model receiving unit receives the requested failure model, and

15 the failure deciding unit decides whether the new electrical appliance is failed or not using the received failure model.

20 16. The remote maintenance system according to Claim 13,  
wherein the home server further includes a failure model holding unit operable to hold a failure model per model of the electrical appliance which is located in each house, and

the failure deciding unit decides whether the electrical appliance of a same model is failed or not using a same failure model.

25 17. The remote maintenance system according to Claim 16,  
wherein the center server further includes:  
an appliance information holding unit operable to hold information regarding an electrical appliance which is located in  
30 each house of a customer who makes a maintenance contract of the electrical appliance with the service center; and  
a failure model distributing unit operable to specify a house

where an electrical appliance of a model corresponding to the updated failure model by referring to the information held in the appliance information holding unit, and distribute the updated failure model to the home server of each specified house.

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18. A remote maintenance system comprising:

a center server that is located in a service center for performing maintenance of an electrical appliance; and

a home server that is located in each house and monitors a status of an electrical appliance in a house,

wherein the center server and the home server are connected via a communication line,

the home server includes:

a status value acquiring unit operable to acquire a status value of each electrical appliance;

a failure model receiving unit operable to receive from the center server a failure model which is information defining a method for deriving a decision whether the electrical appliance is failed or not from the status value;

a failure deciding unit operable to decide whether the electrical appliance is failed or not based on the acquired status value and the received failure model using qualitative reasoning; and

a failure model updating unit operable to update the failure model based on the status value of the electrical appliance,

wherein the failure deciding unit further decides whether the electrical appliance is failed or not based on the acquired status value and the updated failure model using qualitative reasoning.

19. The remote maintenance system according to Claim 18,

wherein the failure model includes a standard value indicating a decision basis for the failure deciding unit to make the decision.

20. The remote maintenance system according to Claim 19,  
wherein the failure model includes a program for having the  
failure deciding unit decide whether the electrical appliance is failed  
or not using the status value and the standard value.

21. The remote maintenance system according to Claim 20,  
wherein the failure model updating unit updates the standard  
value based on the status value using a vector quantization method.

22. The remote maintenance system according to Claim 21,  
wherein the home server further includes a status value  
memorizing unit operable to memorize a status value at the time  
when the failure deciding unit decides that the electrical appliance is  
not failed,

the standard value is a coefficient of a primary curve  
indicating a standard of a normal range when a pair of the status  
value memorized in the status value memorizing unit and a preset  
condition at the time when the status value is acquired is plotted on  
a two-dimensional coordinate, and

the failure model updating unit updates a coefficient of the  
primary curve by a least squares method based on a point indicating  
the status value and the preset condition on the two-dimensional  
coordinate.

23. The remote maintenance system according to Claim 22,  
wherein the failure model includes a program for having the  
status value acquiring unit acquire a predetermined status value at  
a predetermined timing.

24. The remote maintenance system according to Claim 23,  
wherein the home server further includes a customer display

unit operable to display failure information of the electrical appliance,

the failure deciding unit sends information specifying contents of a failure of the electrical appliance to the center server  
5 when the failure deciding unit decides that the electrical appliance is failed, and

the center server further includes:

a holding unit operable to hold different contents of failure information which are prepared beforehand for a customer and a serviceman separately corresponding to a failure which can occur  
10 per model of the electrical appliance;

a failure information sending unit operable to receive information specifying contents of a failure of the electrical appliance, specify failure information for a customer among the  
15 information held in the holding unit, and send the specified failure information to the home server; and

a serviceman display unit operable to receive information specifying contents of a failure of the electrical appliance, specify failure information for a serviceman among the information held in  
20 the holding unit, and display the specified failure information for a serviceman.

25. A remote maintenance method for a remote maintenance system comprising:

25 a center server that is located in a service center for performing maintenance of an electrical appliance; and

a home server that is located in each house and monitors a status of an electrical appliance in a house,

wherein the center server and the home server are connected  
30 via a communication line,

the home server includes:

a failure model receiving step for receiving from the center



server a failure model which is information defining a method for deriving a decision whether an electrical appliance is failed or not from a status value of each of the electrical appliance;

a status value acquiring step for acquiring the status value;

5 a failure deciding step for deciding a failure of an electrical appliance based on the acquired status value and the received failure model using qualitative reasoning; and

a status value sending step for sending the acquired status value to the center server, and

10 the center server includes:

a status value receiving step for receiving the status value from the home server; and

15 a failure model updating step for updating the failure model based on the received status value of the electrical appliance and sending the updated failure model to the home server.

26. The remote maintenance method according to Claim 25,

20 wherein the failure deciding step further includes a specific information sending step for sending information specifying contents of a failure of an electrical appliance to the center server when it is decided that the electrical appliance is failed,

the center server further includes:

25 a specifying step for receiving the information specifying contents of a failure of an electrical appliance, and specifying failure information for a customer and a serviceman in the holding unit;

30 a failure information sending step for reading out the specified failure information for a customer from the holding unit that holds different contents of failure information which are prepared beforehand for a customer and a serviceman separately corresponding to a failure which can occur per model of an electrical appliance, and sending the specified failure information for a customer to the home server; and

a serviceman displaying step for reading out the specified failure information for a serviceman from the holding unit, and displaying the read-out failure information for a serviceman, and

the home server further includes a customer displaying step  
5 for displaying the received failure information for a customer.

27. The remote maintenance method according to Claim 25,  
wherein the home server further includes:

a new electrical appliance detecting step for detecting an  
10 electrical appliance which is newly connected to the home server;  
and

a failure model requesting step for requesting the center  
server to send the failure model corresponding to the electrical  
appliance when the new electrical appliance is detected, and

15 the failure model requested in the failure model requesting  
step is received in the failure model receiving step.

28. A home server that is connected via a communication line  
with a center server which is located in a service center for  
20 performing maintenance of an electrical appliance, and monitors a  
status of an electrical appliance in each house, comprising:

a status value acquiring unit operable to acquire a status  
value of each electrical appliance;

25 a failure model receiving unit operable to receive from the  
center server a failure model which is information defining a method  
for deriving a decision whether the electrical appliance is failed or  
not from the status value; and

30 a failure deciding unit operable to decide whether the  
electrical appliance is failed or not based on the acquired status  
value and the received failure model using qualitative reasoning,

wherein the failure deciding unit decides whether the  
electrical appliance is failed or not according to an updated failure

model after the failure deciding unit receives the updated failure model from the center server.

29. The home server according to Claim 28, comprising:

5 a status value storing unit operable to store a status value at the time when the failure deciding unit decides that the electrical appliance is failed or not failed; and

a status value sending unit operable to send the stored status value to the center server,

10 wherein the failure deciding unit makes the decision according to the updated failure model using the status value which is sent from the status value sending unit.

30. The remote maintenance system according to Claim 29,

15 wherein the failure model includes a standard value indicating a decision basis for the failure deciding unit to make the decision.

31. The remote maintenance system according to Claim 30,

20 wherein the failure model includes a program for having the failure deciding unit decide whether the electrical appliance is failed or not using the standard value and the status value.

32. The remote maintenance system according to Claim 31,

25 wherein the standard value indicates a normal range of a relationship between the status value stored in the status value storing unit and a preset condition of the electrical appliance at the time when the status value is acquired.

33. The remote maintenance system according to Claim 32,

30 wherein the standard value includes a coefficient of a curve indicating a boundary between a normal range and an abnormal range when a pair of the status value and the preset condition is

plotted on a multi-dimensional coordinate.

34. The remote maintenance system according to Claim 33,  
wherein the failure model receiving unit receives the failure  
5 model corresponding to each of the electrical appliance from the  
center server, and

the failure deciding unit decides a failure of the electrical  
appliance according to the failure model corresponding to each of  
the electrical appliance.

35. A center server that is connected with a home server for  
monitoring a status of an electrical appliance in each house via a  
communication line, and is located in a service center for performing  
maintenance of an electrical appliance, comprising:

15 a status value receiving unit operable to receive from the  
home server a status value, a value of each electrical appliance at  
the time when it is decided that the electrical appliance is failed or  
not failed, which is stored in the home server; and

a failure model updating unit operable to update a failure  
20 model that is information defining a method for deriving a decision  
whether the electrical appliance is failed or not from the status value  
based on the received status value of the electrical appliance, and  
send the updated failure model to the home server.

25 36. A program for a home server which is connected with a center  
server which is located in a service center for performing  
maintenance of an electrical appliance via a communication line,  
and monitors a status of an electrical appliance in each house,

the program for having a computer function as:

30 a status value acquiring unit operable to acquire a status value of  
each electrical appliance;

a failure model receiving unit operable to receive from the

center server a failure model which is information defining a method for deriving a decision whether the electrical appliance is failed or not from the status value; and

a failure deciding unit operable to decide whether the electrical appliance is failed or not based on the acquired status value and the received failure model using qualitative reasoning,

wherein the failure deciding unit decides whether the electrical appliance is failed or not according to the updated failure model after the failure deciding unit receives the updated failure model from the center server.

37. A program for a center server which is connected with a home server for monitoring a status of an electrical appliance in each house via a communication line, and is located in a service center for performing maintenance of an electrical appliance,

the program for having a computer function as:

a status value receiving unit operable to receive from the home server a status value, a value of each electrical appliance at the time when it is decided that the electrical appliance is failed or not failed, which is stored in the home server; and

a failure model updating unit operable to update a failure model which is information defining a method for deriving a decision whether the electrical appliance is failed or not from the status value based on the received status value of the electrical appliance, and send the updated failure model to the home server.